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SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1958

No. 932

GIBSON-STEWART COMPANY, INC.,
Petitioner,

WM. BROS BOILER AND MANUFACTURING COMPANY, (Now by Change of Name, BROS, INCORPORATED),
Respondent

PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES CIRCUIT COURT OF APPEALS FOR THE SIXTH CIRCUIT

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INDEX

	Page
Petition for Writ of Certiorari	1
Reports of Opinions Below	1
Grounds for Invoking Jurisdiction of This Court	2
Questions Presented	3
Statutes Involved	3
Statement of The Case	4
Argument	7
Conclusion	14

Appendix

Opinion of the District Court	15
Judgment of the District Court	19
Opinion of the Court of Appeals	21
Judgment of the Court of Appeals	27
United States Letters Patent No. 2,610,557	29
"Pneumatic rollers cut costs of earth fill dams"	35

Table of Cases Cited

Atlantic Works v. *Brady*, 107 U.S. 192 (1882)	7
Brown v. *Brock*, 240 F. 2d 723 (4th Cir. 1957)	13
Georgia-Pacific Corp. v. *United States Plywood Corp.*, 258 F. 2d 124 (2d Cir. 1958)	13
Great Atlantic & Pacific Tea Co. v. *Supermarket Equipment Corp.*, 340 U.S. 147 (1950)	3, 7, 8, 10, 13
Hotchkiss v. *Greenwood*, 52 U.S. (11 How.) 248 (1850)	12
L-O-F Glass Fibers Co. v. *Watson*, 228 F. 2d 40 (D.C. Cir. 1955)	13
Lyon v. *Bausch & Lomb Optical Co.*, 224 F. 2d 530 (2d Cir. 1955)	13
R. M. Palmer Co. v. *Luden's, Inc.*, 236 F. 2d 496 (3rd Cir. 1956)	13
Steffan v. *Weber Heating & Sheet Metal Co.*, 237 F. 2d 601 (8th Cir. 1956)	13
Talko Brothers Slate Co. v. *Hannon*, 157 F. Supp. 277 (D.C. Vt. 1957)	13

Page

Ironton Industries v. *A. E. Peterson Mfg. Co.*, 165 F. Supp. 523 (D.C. S.D. Cal. 1958) 13

Vanity Fair Mills v. *Cusick*, 143 F. Supp. 452 (D.C. N.J. 1956) 13

Vermont Structural Slate Co. v. *Tatko Bros. Slate Co.*, 233 F. 2d 9 (2d Cir. 1956) 13

Zoomar, Inc. v. *Paillard Products*, 258 F. 2d 527 (2d Cir. 1958) 13

Zoomar, Inc. v. *Paillard Products*, 152 F. Supp. 328 (D.C. S.D. N.Y. 1958) 13

CONSTITUTIONAL PROVISIONS CITED

U. S. Const., Art. I, § 8, cl. 8 3

STATUTES CITED

62 Stat. 928, 28 U. S. C. 1254 2
62 Stat. 935, 28 U. S. C. 1338 4
66 Stat. 792, 35 U. S. C. 103 7, 12, 13
66 Stat. 792, Title 35, U. S. C. 3

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"Pneumatic rollers cut costs of earth fill dams", Engineering News-Record, April 2, 1953, Vol. 150, No. 14, Page 30 6, 10, 11

SUPREME COURT OF THE UNITED STATES

OCTOBER TERM, 1958

No.

GIBSON-STEWART COMPANY, INC.,

Petitioner,

v.

WM. BROS BOILER AND MANUFACTURING COMPANY (Now by Change of Name BROS, INCORPORATED),

Respondent

PETITION FOR WRIT OF CERTIORARI

Petitioner, Gibson-Stewart Company, Inc., prays that a writ of certiorari issue to review the judgment of the United States Court of Appeals for the Sixth Circuit herein affirming the decision of the United States District Court for the Northern District of Ohio, Eastern Division.

Reports of Opinions Below

The opinion of the District Court is reported only at 116 U.S.P.Q. 138. The opinion of the Court of Appeals is reported at 264 F.2d 776 and 120 U.S.P.Q. 352. Both opinions, and the judgments in each court, are appended hereto (App. pp. 15, 19, 21, and 27).

Grounds For Invoking Jurisdiction of This Court

The judgment of the Court of Appeals (App. p. 27), which this petition seeks to have reviewed, is dated and was entered February 19, 1959.

There has been no order herein respecting a rehearing or any order granting an extension of time for filing this petition, but the Court of Appeals has stayed its mandate on petitioner's motion until May 20, 1959, pending perfection of this petition.

Jurisdiction is believed to be conferred on this Court to review the judgment in question by writ of certiorari under the provisions of the Act of June 25, 1948, c. 646, 62 Stat. 928, 28 U.S.C. 1254.

The jurisdiction of this Court is invoked on the ground that a federal question arising under the patent laws of the United States has been decided herein in a way believed in direct and obvious conflict with an exactly applicable prior decision of this Court, which is the Court's last decision in point; and on the further ground that the federal question decided herein is of particular importance in that it arises under patent laws of the United States, which were enacted since this last applicable prior decision, and which include a new statutory definition of "conditions for patentability" which this Court has not yet construed, but should, we respectfully submit, in order to settle continuing speculation as to the relation of this new statutory definition to the Court's applicable prior decisions.

Questions Presented

1. Whether imposing size and supposed complexity of the patented earth compacting roller in this case were properly found by the United States Court of Appeals for the Sixth Circuit to distinguish the otherwise exactly ap-

plicable decision of this Court in *Great A. & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U. S. 147 (1950).

2. Whether an earth compacting roller incorporating admittedly old elements in an arrangement suiting government specifications for use in constructing earth fill dams, airport runways, and in other public works, was properly found by the United States Court of Appeals for the Sixth Circuit to warrant imposing a patent monopoly on an industry in which the admittedly old elements had previously been commonly employed in similar earth compacting rollers.

3. Whether the standard of invention for combination patents was properly applied by the United States Court of Appeals for the Sixth Circuit in treating the decision of the District Court on the issue of validity as a finding of fact.

4. Whether the standard of invention for combination patents as prescribed by this Court in *Great A. & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U. S. 147 (1950), has been in any way qualified by the subsequent addition of Section 103, Title 35, United States Code (Act of July 19, 1952, c. 950, 66 Stat. 792), to the patent laws of the United States.

Statutes Involved

Beyond the constitutional provision for the issuance of patents (Art. I, § 8, cl. 8) and, in general, the patent laws of the United States enacted pursuant thereto (Act of July 19, 1952, c. 950, 66 Stat. 792, Title 35, United States Code), the questions presented herein involve in particular a newly added provision of the patent laws (Section 103 of Title 35) which is as follows:

> "§ 103. *Conditions for patentability; nonobvious subject matter.*

"A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

Statement of the Case

This case involves an action for patent infringement in which jurisdiction by the district court of first instance was acquired under the provisions of the Act of June 25, 1948, c. 646, 62 Stat. 931, 28 U.S.C. 1338.

The action is based on alleged infringement of respondent's United States Letters Patent No. 2,610,557, issued September 16, 1952, and covering an earth compacting roller that has the form of a cart; the roller wheels being arranged along a single transverse axis midway of a ballast carrying body, and the body being pulled by a suitable forward hitch.

The bottom of the body is arched over two pairs of roller wheels that are mounted on transversely aligned separate axles carried by respective longitudinal rocker beams allowing the wheel pairs to oscillate so that all of the wheels tend to maintain contact with the ground on a surface that is not level. Each roller wheel is fitted with a pneumatic tire. All of the elements of this patented earth compacting roller are admittedly old in the prior art.

The patented structure is defined by four claims that are set out fully in a copy of the patent in suit appended

to this petition (App. p. 29). Claim 1, the shortest one, is quoted below for present illustration:

> "1. An earth compaction roller comprising a hollow body member adapted to receive weight producing ballast and having a transversely extending arched recess between its front and rear ends, an axially aligned series of pneumatic tired wheels mounted in said recess to support the body member with its center of gravity substantially over the wheels, and a draft beam extending longitudinally through the lower part of the body, centrally thereof, said draft beam transversing said arched recess between two of such wheels and rigidly connecting opposite wall portions of the recess."

The decision of the District Court (App. p. 15) indicates that "the defendant at the trial admitted infringement was present if the patent claims were valid." Both the District Court and the Court of Appeals found the claims valid on grounds summarized by the following portions from the decision of the Court of Appeals (App. p. 21) that this Court is petitioned to review.

First, in describing the findings of the District Judge, the Court of Appeals said:

> "On the issue of validity of the patent, the judge considered it more than a mere aggregation or assembly of well-known elements in the road-building art where densification of the ground is one of the principal accomplishments desired and compaction is another. He thought that the need for a marketable machine for compaction had been fulfilled by the appellee in a new and useful way, even though it had been necessary to use the prior art and structures to accomplish it."

Secondly, in explaining the conclusion of the District Judge as to patentability, the Court of Appeals said:

> "Judge Jones . . . concluded that the arrangement of the patented structure, distributing the load equally in all portions as it does, required more than ordinary mechanical and engineering skill for accomplishment."

Thirdly, the Court of Appeals stated:

> "It is established, of course, that in a patent case the findings of fact of the district court—unless clearly erroneous—should not be disturbed. Modern Products Supply Co. v. Drachenberg, 152 F.2d 203, 207 (C. A. 6). This principle applies to issues of both validity and infringement."

Finally, the Court of Appeals dealt with the last applicable prior decision of this Court as follows:

> "It would seem that the opinion of the Supreme Court in Great Atlantic & Pacific Tea Company v. Supermarket Equipment Corp., 340 U. S. 147, is not applicable here because of the vast difference in the *complexities* of the two inventions." (Emphasis added.)

The significance of pneumatic earth compacting rollers and the government specifications to which the patented earth compacting roller in this case was adapted are reviewed at length in *Pneumatic rollers cut costs and time on earth fill dams*, by George E. Bretram, Engineer, Office of the Chief of Engineers, Washington, D. C., Engineering News-Record, April 2, 1953, Vol. 150, No. 14, Page 30; a copy of which is appended to this petition for judicial notice (App. p. 35).

Argument

Summary:

I. There is believed to be unmistakable conflict, on strikingly parallel facts, between the decisions herein and the last applicable prior decision of this Court in *Great A. & P. Tea Co.* v. *Supermarket Equipment Corp.*, 340 U. S. 147 (1950).

II. As every element of the patented earth compacting roller in this case is admitted to be old, and to have been used by the industry previously in earth compacting rollers, the patented arrangement of these admittedly old elements covered by the patent in suit is submitted to represent a studied attempt "to watch the advancing wave of improvement, and gather its foam in the form of patented monopolies," as was condemned by the decision of this Court in *Atlantic Works* v. *Brady*, 107 U. S. 192, 200 (1882).

III. It was error for the Court of Appeals to treat the issue of validity as if it were a finding of fact, and not to review the question of patentability by the standard of invention for combination patents prescribed by the decision of this Court in *Great A. & P. Tea Co.* v. *Supermarket Equipment Corp.*, 340 U. S. 147 (1950).

IV. The newly enacted "conditions for patentability" embodied in Section 103 of Title 35, United States Code, were not properly applied by the District Court and the Court of Appeals in determining the question of patentability herein, unless this Section 103 has changed the standard of invention for combination patents prescribed by the last applicable decision of this Court in *Great A. & P. Tea Co.* v. *Supermarket Equipment Corp.*, 340 U. S. 147 (1950).

I

The Court of Appeals has held herein that the decision of this Court in *Great A. & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U. S. 147 (1950) "is not applicable here because of the vast difference in the complexities of the two inventions." But the invention here is simply a large cart, as appears on the face of the patent in suit (App. p. 29), and it is submitted that the facts of the two cases could hardly be more closely aligned, as may be seen from a comparison such as follows:

Great A. & P. Tea Co. v. Supermarket Equipment Corp., supra.	**The present case for which review is sought by this petition.**
"Two courts below have concurred in holding three patent claims to be valid . . ."	The District Court and Court of Appeals below have both found all four claims of the patent in suit valid.
". . . it is stipulated that, if valid, they (i. e., the claims) have been infringed."	The District Court herein said that "the defendant at the trial admitted infringement was present if the patent claims were valid."
"The District Court explicitly found that each element in this device (i. e., the patented one) was known to prior art."	The District Court herein said: "Now, of course, the arched recess is old. . . . The oscillation and rocker beam idea was not new, and the plaintiff does not claim originality or novelty of most of these elements that have gone into its structure."

The A. & P. case
(continued)

"'However,' it (i. e., the District Court) found, 'the conception of a counter with an extension to receive a bottomless self-unloading tray with which to push the contents of the tray in front of the cashier was a decidedly novel feature and constitutes a new and useful combination.'"

The Court of Appeals regarded this finding of invention (i. e., by the District Court) as one of fact . . ."

The Court of Appeals regarded the District Court finding of invention as being "... sustained by substantial evidence . . ."

The present case
(continued)

The District Court herein said: "You had to have an arrangement which would distribute the load equally in all portions. . . .

"So that I think, on the whole, the equalizing of the weight by the disposition of these wheels and the recessed part was not exactly shown in anything that had gone before."

The Court of Appeals herein held that the principle against disturbing District Court findings of fact, unless clearly erroneous, "applies to issues of both validity and infringement."

The Court of Appeals herein said: "There was ample basis in the testimony of expert witnesses to support his (i. e., the District Judge's) deductions."

The A. & P. case (continued)	The present case (continued)
The Court of Appeals affirmed the District Court finding of invention ". . . as not clearly erroneous."	The Court of Appeals herein said: ". . . the trial judge made an adequate, succinct and accurate statement of the reasons for which the claims of the patent were considered valid."

It is submitted that whatever seemed below to be complex in the patent in suit will not stand simple scrutiny, and that the mere size of the respondent's patented earth compacting roller provided no basis for distinguishing the decision of this Court in *Great A. & P. Tea Co. v. Supermarket Equipment Corp., supra.*

II

Rather than the respondent filling any long felt need, the patented earth compacting roller in this case actually responded to specifications developed over a period of years by the United States Corps of Engineers, as reviewed authoritatively in the article appended to this petition (App. p. 35), and the apparent commercial success in this case is based, in point of fact on the development work of the Corps of Engineers rather than anything that respondent did.

Datewise, it is significant that the studies of the Corps of Engineers began in 1947 (App. p. 35), and that in the spring of 1949 after "success with a pneumatic roller at Dorena Dam led to the preparation of specifications for what appeared to be a desirable type of pneumatic roller for use on earth fills at Lookout Point Dam," the Corps of

Engineers solicited bids "on two rollers that would meet those specifications." Respondent was the successful bidder (App. p. 35). The application for the patent in suit was not filed until the next fall—November 17, 1949.

Accordingly, the patent in suit was clearly an afterthought designed to obtain a patent monopoly on a lucrative adaption of old elements, which neither the respondent nor anyone else initially considered to involve patentable invention, and which evolved simply in suiting the old elements routinely to specified requirements indicated by extensive development work of a public agency substantially before any application for the patent in suit was filed.

III

The opinion of the Court of Appeals herein describes at length the findings and conclusions of the District Court, and then cites authority for the rule that trial court findings of fact, unless clearly erroneous, should not be set aside and couples this citation with a statement that the same "principle applies to issues of both infringement and validity."

On such a basis it is submitted that there is no review of the question of patentability, but only a consideration of the trial record to determine whether the findings and conclusions of the District Judge were supported by evidence. The Court of Appeals herein found that: "There was ample basis in the testimony of expert witnesses to support his deductions." It appears then that these "deductions" were not considered "clearly erroneous" and, therefore, affirmed.

The rule announced by this Court in *Great A. & P. Tea Co. v. Supermarket Equipment Corp., supra*, is believed to be plainly to the contrary.

IV

In this case, the opinion of the District Court characterized the substance found in the claims of the patent in suit as follows:

> "You had to have an arrangement which would distribute the load equally in all portions, as I think the plaintiff's structure does, placed in the center of the box or the bed, whatever they call it, and made to oscillate, which, as I say, wasn't new, but the arrangement which I think was made there required something more than just ordinary mechanical or engineering skill to accomplish."

The opinion of the Court of Appeals said:

> "In the light of the record, we think it would be an all too sweeping and incorrect generalization to say that the subject matter of the patent in suit would be obvious to those schooled in the art at the time the invention was disclosed."

These statements in the opinions below necessarily amount to determinations made in finding compliance with the "conditions for patentability" contained in the newly enacted Section 103 of Title 35, United States Code, which now requires by statute that patented subject matter must not be "obvious . . . to a person having ordinary skill in the art. . . ."

The statutory statement of this requirement by Section 103 of Title 35 has been construed as adopting the rule first announced by this Court in *Hotchkiss v. Greenwood*, 52 U. S. (11 How.) 248 (1850), and as changing the standard of invention imposed by later decisions to the extent that the later decisions applied "a stricter test of invention."

Lyon v. *Bausch & Lomb Optical Co.*, 224 F. 2d 530, 534 (2d Cir., 1955), cert. denied 350 U. S. 911 (1955). See also Frederico, Commentary On The New Patent Act, 35 U. S. C. A. §§ 1-101 (1954), pp. 1, 19.

This construction in *Lyon* v. *Bausch & Lomb Optical Co.*, *supra*, has been referred to with apparent approval and disapproval in subsequent decisions of the same court. Compare *Georgia-Pacific Corp.* v. *United States Plywood Corp.*, 258 F. 2d 124, at 133 (2d Cir. 1958), with *Vermont Structural Slate Co.* v. *Tatko Brothers Slate Co.*, 233 F. 2d 9, n. 3 at 11 (2d Cir. 1956). It has been similarly noted by other circuits. Compare *I. Ost Glass Fibers Co.* v. *Watson*, 238 F. 2d 40, n. 14 at 47 (D. C. Cir. 1955), and *Brown* v. *Brock*, 240 F. 2d 723, at 728 (4th Cir. 1957), with *R. M. Palmer Co.* v. *Luden's, Inc.*, 236 F. 2d 496, at 499 and 500. (3rd Cir. 1956). It has led patentees regularly to urge a relaxed standard of invention. See, for example, *Vermont Structural Slate Co.* v. *Tatko Brothers Slate Co.*, *supra* at 11; *Zoomar, Inc.* v. *Paillard Products*, 258 F. 2d 527, at 530 (2d cir. 1958); *R. M. Palmer Co.* v. *Luden's, Inc.*, *supra*, at 498; *Steffan* v. *Weber Heating And Sheet Metal Co.*, 237 F.2d 601, at 604 (8th Cir. 1956). It has developed signs of confusion and conflict in the district courts. See, *Vanity Fair Mills* v. *Casick*, 143 F. Supp. 452, at 459 (D. C. N. J. 1956); *Zoomar, Inc.* v. *Paillard Products*, 152 F. Supp. 328, n. 1 at 331 (D. C. S. D. N. Y. 1957); *Tatko Brothers Slate Co.* v. *Hannon*, 157 F. Supp. 277, at 283 (D. C. Vt. 1957); *Trenton Industries* v. *A. E. Peterson Mfg. Co.*, 165 F. Supp. 523, at 527 (D. C. S. D. Cal. 1958).

This Court has not yet had occasion to consider the provisions of Section 103 of Title 35 but, unless the standard of invention for combination patents prescribed by the Court in *Great A. & P. Tea Co.* v. *Supermarket Equipment*

Corp., supra, has been changed by this subsequent addition to the patent laws of the United States, it is submitted that the decisions below are in clear conflict with these provisions and should be reviewed.

Conclusion

WHEREFORE, it is respectfully submitted that this petition should be granted.

GIBSON-STEWART COMPANY, INC.,
By WARLEY L. PARROTT,
Attorney for Petitioner.

PARROTT & RICHARDS,
Of Counsel.

APPENDIX

APPENDIX

District Court, N. D. Ohio, E. Div.

Wm. Bros Boiler and Manufacturing Company,

by change of name

Bros Incorporated

v.

Gibson-Stewart Co. (Inc.)

Decided Nov. 26 and Dec. 16, 1957

No. 31158

Patents

Particular patents—Roller Compactor

2,610,557, Bros, Pneumatic Roller Compactor, claims 1 to 4 valid and infringed.

Action by Wm. Bros Boiler and Manufacturing Company, by change of name Bros Incorporated, against Gibson-Stewart Co. (Inc.) for patent infringement.

Judgment for plaintiff.

Andrew E. Carlsen, Douglas L. Carlsen, and Carlsen & Hazle, all of Minneapolis, Minn., and John F. Oberlin and Oberlin & Limbach, both of Cleveland, Ohio, for plaintiff.

Cecil L. Wood, Fort Worth, Tex., Kuth & Cole, Cleveland, Ohio, and Frank E. Liverance, Jr., Grand Rapids, Mich., for defendant.

Jones, Chief Judge (orally).

Well, as I rather indicated when the plaintiff made its motion earlier this afternoon, my first impression was that the defendant had failed to carry the burden of proof required of it in patent cases. It seems to me that in order to have successfully carried the burden it is essential that

the defendant analyze these earlier structures and the elements involved in them, which the defendant characterizes as all old and an aggregation of old elements in the prior art, as something more than just to cast aspersions on them, which I really think the defendant has, and pass them off as a mere assembly or aggregation of well known elements in the same art that the plaintiff has put together, or the inventors of the plaintiff's machine, have put together, and which allegedly should have been obvious to one skilled in that art or to an engineer.

I felt that to sustain a motion on that basis would not have done justice, perhaps, to the plaintiff, when the defendant at the trial admitted infringement was present if the patent claims were valid.

Perhaps I ought to say a little more to justify my judgment of validity against the defendant and briefly to state what I think about the patent.

I believe this patent is something more than just an aggregation or an assembly of well-known elements of the road building art where the ground is to be densified, or densification is one of the principal accomplishments to be had and compaction is another. There apparently must have been a need for some sort of marketable machine with all these necessary ingredients and elements that would accomplish what the market and the trade wanted; and the plaintiff fulfilled this in a new and useful way, even though it was necessary to use the prior art and prior structures to accomplish it.

This was an art in which it was necessary to have tremendous weight, and in order ordinarily to carry tremendous weight and to accomplish adequate densification and compaction it was necessary to keep the machine within reasonable limits because otherwise if you scatter your ammunition all over the place you don't accomplish the main thing, you miss the mark. But here the problem was to bring these elements together in a compact unit that would do the job that was necessary to be done in this art by the use of means which would make the completed structure one which was easy to manipulate and which accomplished all that the older machines and structures ac-

complished; and bring it within the range of the possibility of the market wanting that machine to do its work.

Now, of course, the arched recess is old, as shown here. I don't think that, standing alone, was anything new to put into this combination of elements; it was useful, however. The oscillation and rocker beam idea was not new, and the plaintiff does not claim originality or novelty of most of these elements that have gone into its structure. It does claim novelty, usefulness and commercial acceptance for the manner in which it has put these together, not, I think, as an aggregation or assembly, but as a combination which accomplishes the job that was sought to be accomplished in a new and better way. And the fact that it is conceded here that it has been received with commercial success; if there were any doubt about the validity at all (but there is not in my mind), that might have been sufficient to carry it over.

Now that was recognized by Mr. Grace, representing the defendant here in the defense of the suit, in the fact that he did actually copy the plaintiff's structure. And when I asked him yesterday—I think it was after he was at the blackboard—whether he ever (prior to plaintiff's invention) had produced a roller with oscillating two-wheel sets of four wheels in the manner in which the plaintiff had put them together, he said he had not had that precise arrangement.

Now, while I say that the arched recess is not new, nevertheless, the central draft beam of the plaintiff's conception, running from the forward end, through the arched recess, and hooked up in the back. Perhaps that, per se, might have been obvious to an engineer in building a structure to withstand the stresses and strains and the pull which would be involved in pulling the heavy load. There is also the rocker beam which served the two-fold purpose of maintaining the edges of the arch or the base of the arched recess in parallelism on each side. It served that purpose, as well as that of furnishing the support for the axle upon which each two wheels were placed.

Of course, the heavy loads that were essential to ac-

complish the purpose made it necessary to find or to develop and produce a machine or a roller which could be moved with reasonable ease and didn't require tremendous distances, like some of these earlier structures. You have to have something that was mobile, that could be carried about. You had to have an arrangement which would distribute the load equally in all portions, as I think the plaintiff's structure does, placed in the center of the box or the bed, whatever they call it, and made to oscillate, which, as I say, wasn't new, but the arrangement which I think was made there required something more than just ordinary mechanical or engineering skill to accomplish.

So that I think, on the whole, the equalizing of the weight by the disposition of these wheels and the recessed part was not exactly shown in anything that had gone before. I think there was no doubt a previous Browning structure which was in two parts, which I called a doubleheader, which appears taken apart, but the load distributed to those two rollers, when taken apart, would not have been adequate to accomplish the purpose, no matter how heavy a load was put on it, that is, accomplish the purpose of the plaintiff's structure.

So that I think the spacing of the wheels themselves, although they appear in some of the other early structures, they were spaced differently because they were alternating wheels—staggered is the word I was trying to think of—so the whole area could be covered by two separate sets of wheels, one at one end of the structure and one at the other. But this arrangement of the plaintiff accomplished the purpose, as I understand the theory, of bringing the whole load to bear uniformly on the sub-surface and accomplish in a more concise and compact way that which had been up to that accomplished by the staggered wheels.

That is about all that I feel is necessary to say. There are no other issues in the case. There is no question that the patent was issued on the date in question. There is no question that the plaintiff is the owner of the patent and has the right to sue. So there are really no other defenses than those I have indicated in my remarks here given, that need be covered. I feel what I have said here

is sufficient findings and conclusions to comply with Rule 52(a) of the Rules of Civil Procedure.

So that, feeling as I do about the matter, and with that analysis, I feel justified in permitting a decree of validity to be entered here, and judgment for the plaintiff. It will be so ordered.

JUDGMENT

This cause came regularly on for trial with evidence being offered and arguments submitted by both parties, and at the conclusion thereof on November 26, 1957 the Court rendered its opinion, incorporating therein Findings of Fact and Conclusions of Law. Pursuant to such proceedings—

It is Ordered, Adjudged and Decreed:

1. This Court has jurisdiction of the subject matter of this suit and the parties hereto.

2. Plaintiff, Bros Incorporated, a Minnesota corporation, located in Minneapolis, Minnesota, is the owner of United States Letters Patent No. 2,610,557, issued September 16, 1952, for Pneumatic Roller Compactor, and has all rights to the recovery of damages and profits for infringement thereof.

3. Claims 1, 2, 3 and 4, of said Bros et al. Patent No. 2,610,557 are good and valid in law.

4. Defendant, Gibson-Stewart Co. (Inc.), an Ohio corporation, located in Cleveland, Ohio has infringed all four claims of the aforesaid Bros et al. Letters Patent No. 2,610,557 by selling machines identified as Grace 50 Ton Soil Compaction Rollers, manufactured by the W. E. Grace Manufacturing Company, a Texas corporation located at Dallas, Texas.

5. That a permanent injunction issue out of and under the seal of this Court directed to corporate Defendant, Gibson-Stewart Co. (Inc.), enjoining and restraining said Defendant, its officers, directors, associates, attorneys, clerks, agents, servants, workman and employees, and each of them from directly or indirectly making or causing to be made, using or causing to be used, selling or causing to be sold,

leasing or causing to be leased, advertising or offering for sale, use or lease, machines or devices employing the invention set forth and claimed in said United States Letters Patent No. 2,610,557, or any substantial equivalent thereof, and from infringing upon or contributing to the infringement of said patent in any way whatever.

6. That the Plaintiff recover from the Defendant all the profits, gains and advantages which Defendant has received or which have arisen or accrued by reason of said infringement, and the damages resulting therefrom, and to that end the case shall be referred to a master, who shall, upon application, be appointed by the Court to take and state an account of the amount of recovery hereunder, and report his conclusion to the Court.

7. That the Plaintiff recover from the Defendant the actual Court costs to be taxed by the Clerk.

Dated: December 16, 1957.

Filed February 19, 1959. Carl W. Reuss, Clerk

No. 13,500

UNITED STATES COURT OF APPEALS FOR THE SIXTH CIRCUIT

GIBSON-STEWART COMPANY, INC., *Appellant*

v.

WM. BROS BOILER AND MANUFACTURING COMPANY, *Appellee*

Appeal from the United States District Court for the Northern District of Ohio

Decided February 19, 1959

Before ALLEN, Chief Judge; MARTIN, Circuit Judge; GOURLEY, District Judge.

MARTIN, Circuit Judge. In this suit for patent infringement, the able and experienced district judge held the four claims of Bros, et al., Patent (No. 2,610,557) to be valid and infringed by the appellant, Gibson-Stewart Company, Inc.

As stated by the patentee, the invention in the patent in suit relates to the art of compacting earth for roads, highways, airport runways, fills for dams, etc., where deep penetration and uniform but maximum density are important objectives and where the primary purpose is to provide a novel, efficient and practical pneumatic-tired compactor that will effectively, yet economically, meet these rigid objectives or requirements. The inventor stated that a typical exigency is presented by airport runways, which must receive and support aircraft weighing as much as three hundred thousand pounds. It was said further, in the patent application, that the resulting impact is such as to break down the runway pavement, unless properly constructed bt base courses and sub-grades which have been compacted to an extremely high degree of density and to a depth of as much as five to six feet below the surface.

The inventor then goes further to detail the specifications in the patent and makes four claims; all of which, as heretofore stated, were upheld by the district court.

Claim One is for an earth compaction roller comprising a hollow body member adapted to receive weight-producing ballast and having a transversely extending arched recess between its front and rear ends, an axially aligned series of pneumatic-tired wheels mounted in such recess to support the body member with its center of gravity substantially over the wheels, and a draft beam extending longitudinally through the lower part of the body, centrally thereof, such draft beam traversing the arch recess between two of such wheels and rigidly connecting opposite wall portions of the recess.

The other claims are in substance, as follows:

Claim Two. A unitary body structure having the central recess and employing two pairs of wheels—one of which is under each side—each pair being carried by the support beam additionally operating to maintain the lower ends of the recess wall in parallelism.

Claim Three is similarly limited to the use of four wheels and mountings in the recess; but this claim is directed specifically to the feature of arranging the four wheels so that they will carry equal loads and be spaced to produce equal compaction pressures in equally spaced paths.

Claim Four, in a general way, is similar to Claim Three; but it includes the parallelism-maintaining characteristic in addition to the wheel-spacing arrangement, which is specifically confined to an arrangement in which the space between any two wheels is less than the width of the tread of one wheel so as to prevent any substantial movement of earth upwardly between the tires.

The district judge received in evidence various exhibits revealing the prior art. He heard testimony of experts and other witnesses, analyzed the case and rendered an oral opinion, subsequently revised. He stated that "the defendant at the trial admitted infringement was present if the patent claims were valid."

On the issue of validity of the patent, the judge considered it more than a mere aggregation or assembly of well-known elements in the road-building art where densification of the ground is one of the principal accomplishments desired and compaction is another. He thought that the need for a marketable machine for compaction had been fulfilled by the appellee in a new and useful way, even though it had been necessary to use the prior art and structures to accomplish it. He considered that the problem solved by the inventor had been to bring together in a compact, efficient unit the necessary elements to meet a need by the use of means which would make the completed structure an easy one to manipulate, while accomplishing all that the old machines and structures had done. He stated that the arched recess is old and, standing alone, put nothing new into the combination of elements, being useful nevertheless. He said further that the oscillation and rocker-beam idea was not new and that the appellee did not even claim originality or novelty for most of the elements embraced in the structure. But he well reasoned that novelty, usefulness and commercial acceptance for the manner in which the known elements were put together—not as a mere aggregation, but as a combination which accomplishes the job sought to be accomplished in a new and better way—was manifest.

The judge asserted that it had been conceded on the trial that the structure had met with commercial success which, had there been doubt about the validity of the patent, might have been sufficient to maintain validity. There was no doubt in the mind of the judge as to validity of the patent.

Judge Jones went into further discussion of the elements of the patent and concluded that the arrangement of the patented structure, distributing the load equally in all portions as it does, required more than ordinary mechanical and engineering skill for accomplishment. The distinguished jurist thought that, on the whole, the equalizing of the weight by the distribution of the wheels of the patent in suit and the recess part were not shown exactly by anything in the prior art. He considered the Browning struc-

ture in the prior art distinguishable, in that the load distributed to the two rollers—when taken apart—would not have been adequate to accomplish the purpose of the patent structure.

The judge reasoned that the spacing of the wheels themselves in Browning, although apparent in some structures, was staggered differently because they were alternating wheels, with the result that the whole area could be covered by two separate sets of wheels: one at one end of the structure and one at the other. He concluded that the arrangement of the patent in suit, accomplished the purpose of bringing the whole load to bear uniformly on the subsurface and effected in a more concise, compact way what had been attained previously by the staggered wheels.

Accordingly, a permanent injunction was issued against infringement by appellant of the patented structure; and the customary reference to a Master was ordered for an accounting to ascertain the profits and damages due by appellant to appellee. We are of opinion that the judgment of the district court should be affirmed.

Williams Manufacturing Co. v. *United Shoe Machinery Corp.*, 121 F. (2d) 273, 277 (C. A. 6), decided June 27, 1941 [affirmed, 316 U. S. 365], was the first case at that time in which, for some fifteen years, the Supreme Court in an opinion had upheld the validity of a patent. In that case, Judge Simons, speaking for our court, said: "To the presumption of validity that attaches to a granted patent, where the most pertinent prior art has been cited against it in the patent office, there must probably now be added the force of a growing recognition of finality that is generally being accorded to administrative determinations supported by evidence, on the ground that the administrative agency is expected to have developed an expertness in its specific field beyond what may be expected from the courts wherein adjudications range the whole field of human controversies. It is true, of course, that in the most strict sense, the granting of a patent is not, except when an interference is declared, the result of an adversary proceeding, as in usual administrative determinations of agencies

exercising quasi-judicial functions. Nevertheless it wears, in the broader sense, an adversary aspect, since patent office examination protects the public against unmerited monopoly, and so the public, as represented by the examiner, is always impliedly in adversary position to the application just as it is ~~even~~ a third party to an infringement suit. *Kellogg Switchboard & Supply Co.* v. *Michigan Bell Telephone Co.*, 6 Cir., 99 F. 2d 263. To the inferences in support of validity thus noted, must now be added the implication of correctness that attaches to the findings and conclusions of the District Judge who heard the testimony of the witnesses and saw the machines in operation." It was pointed out, moreover, that an infringer who assails the validity of a patent, fair upon its face, bears a heavy burden of persuasion and fails unless his evidence has more than a dubious preponderance.

In *Trabon Engineering Corporation* v. *Dirkes*, 136 F. (2d) 24, 27 (C. A. 6), Judge Simons gave expression to a principle directly pertinent in the present controversy. He stated that "long recognition of an existing problem in any art, and the advantages to accrue to an industry from its solution, have been considered as highly persuasive of invention when success is finally achieved; that sometimes achievement is revolutionary, but more often an inventor begins where others leave off, and perceives the vital forward step to which predecessors had been blind."

It is established, of course, that in a patent case the findings of fact of the district court unless clearly erroneous should not be disturbed. *Modern Products Supply Co.* v. *Drachenberg*, 152 F. (2d) 203, 207 (C. A. 6). This principle applies to issues of both validity and infringement.

Illustrative cases from this circuit, holding that a combination patent should not be invalidated by the mere fact that certain elements of the combination are old if invention inheres in the combination, are, among others: *General Motors Corporation* v. *Swan Carburetor Co.*, 88 F. (2d) 876, 887 (C. A. 6); *International Visible Systems Corp.* v. *Remington-Rand, Inc.*, 78 F. (2d) 696 (C. A. 6).

It would seem that the opinion of the Supreme Court in *Great Atlantic & Pacific Tea Company* v. *Supermarket*

Equipment Corp., 340 U. S. 147, is not applicable here because of the vast difference in the complexities of the two inventions. There, the condemned invention consisted simply in opening up the apex of the equivalent of an ordinary pool ball rack so that the legs of the triangle became parallel to each other and perpendicular to the base, the open rack being merely hand-pushed along an elongated table in the handling of food sold in stores. The pushing element was not automatic—not even mechanical.

Here, as has been previously shown, the huge patented device was highly complicated and most ingeniously designed; and it served a purpose not theretofore known for practical requirements in its field.

Judge Allen has written for this court a carefully considered opinion in which are set forth several principles applicable to the instant case. *Cold Metal Process Company* v. *Republic Steel Corp.*, 233 F. (2d) 828 (C. A. 6). The opinion contains a wealth of citations of value to the patent bench and bar. To quote a few excerpts, the opinion stated: [p. 837] "The long-standing want and insistent demand satisfied by the patentee demonstrate the existence of invention. *Goodyear Tire & Rubber Co., Inc.* v. *Ray-O-Vac Co.*, 321 U. S. 275, 279, 64 S. Ct. 593, 88 L. Ed. 721; *Watson* v. *Heil*, 4 Cir., 192 F. (2d) 982, 985, * * * [pages 838-9]. In order to secure a true and patentable combination of old elements, the elements must co-act to produce the result achieved, the result must be new and useful, and the method of operation must be new. *Great Lakes Equipment Co.* v. *Fluid System, Inc.*, 6 Cir., 17 F. (2d) 613, 617. If the method of operation is new and the result is new, the old elements perform a new function in their new environment." The opinion stated also: [p. 837] "The best of the art relied on here [as in the instant case] was before the Patent Office and this fact strengthens the presumption of validity. *Modern Products Supply Co.* v. *Brachenberg*, 6 Cir., 152 F. (2d) 203, 205, certiorari denied 327 U. S. 806, 66 S. Ct. 964, 90 L. Ed. 1030."

As we think has been hereinbefore indicated, the trial judge made an adequate, succinct and accurate statement of the reasons for which the claims of the patent were

considered valid. There was ample basis in the testimony of expert witnesses to support his deductions. In the light of the record, we think it would be an all too sweeping and incorrect generalization to say that the subject matter of the patent in suit would be obvious to those schooled in the art at the time the invention was disclosed. We think the objective was attained by the claims of the patent to provide a pneumatic-tired roller, so constructed and of such weight as to produce compaction of sufficient magnitude to bring about deeper penetration and more intense densification than had been accomplished before, without the sacrifice of rigidity of body or maneuverability. The roller was also kept within the limitation of ground area.

Upon careful analysis, the claims of the patent in suit seem to present a distinctive inventive concept which had no equivalency in the prior art. We think that neither the oscillating wheels of Grace, nor the body in Browning, nor Porter's wheel-spacing represents anticipation of the combination patent in suit.

Accordingly, for the reasons set forth in this opinion and in that of the United States District Judge as herein analyzed, the judgment of the district court is affirmed.

JUDGMENT

(Filed February 19, 1959)

Appeal from the United States District Court for the Northern District of Ohio.

This cause came on to be heard on the transcript of the record from the United States District Court for the Northern District of Ohio, and argued by counsel.

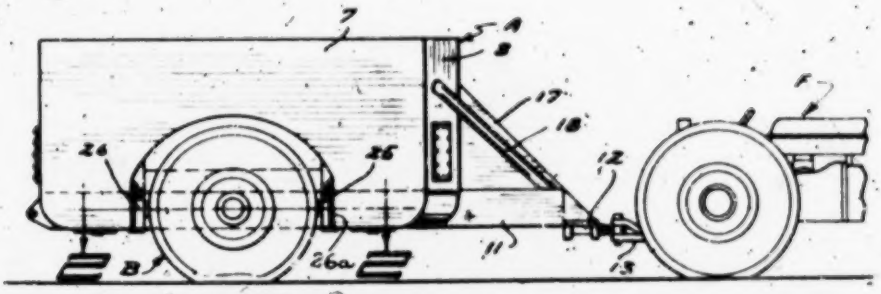
On consideration whereof, it is now here ordered and adjudged by this court that the judgment of the said District Court in this cause be and the same is hereby affirmed.

Sept. 16, 1952 C. W. BROS ET AL 2,610,557

PNEUMATIC ROLLER COMPACTOR

Filed Nov. 17, 1949 3 Sheets-Sheet 1

FIG. 1



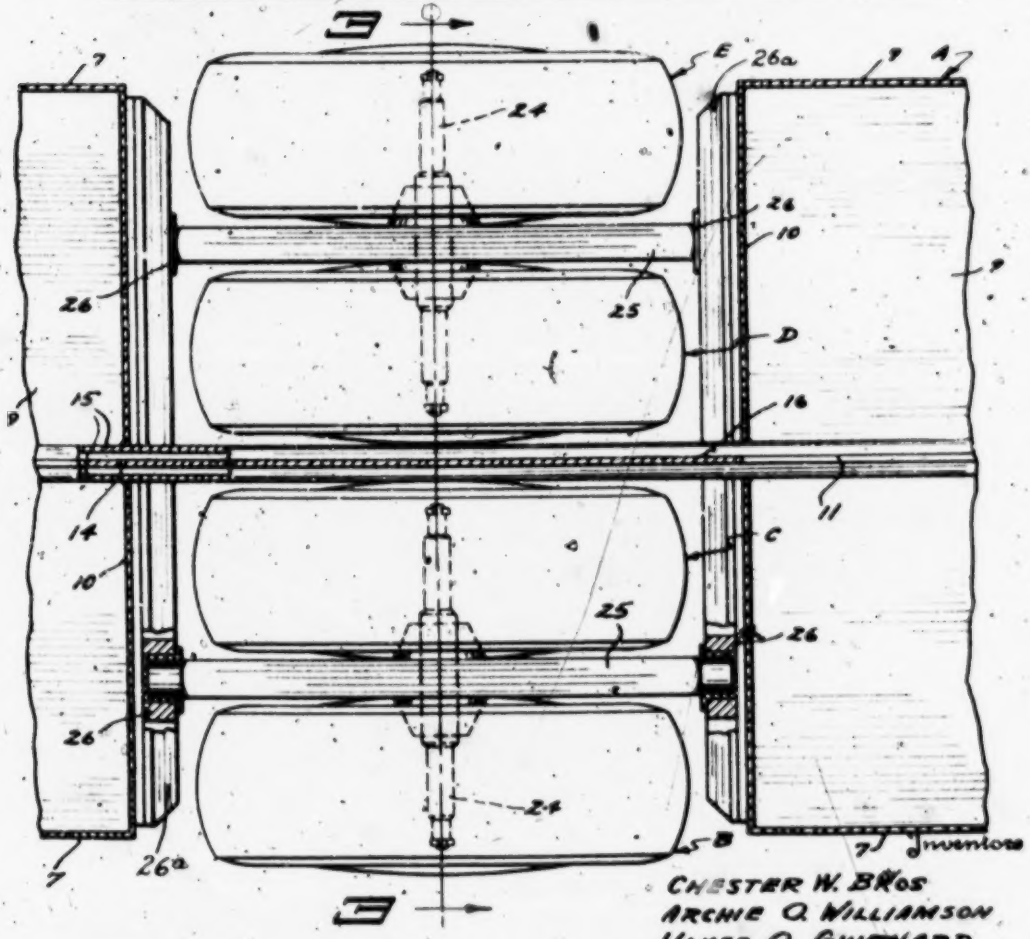


FIG. 2

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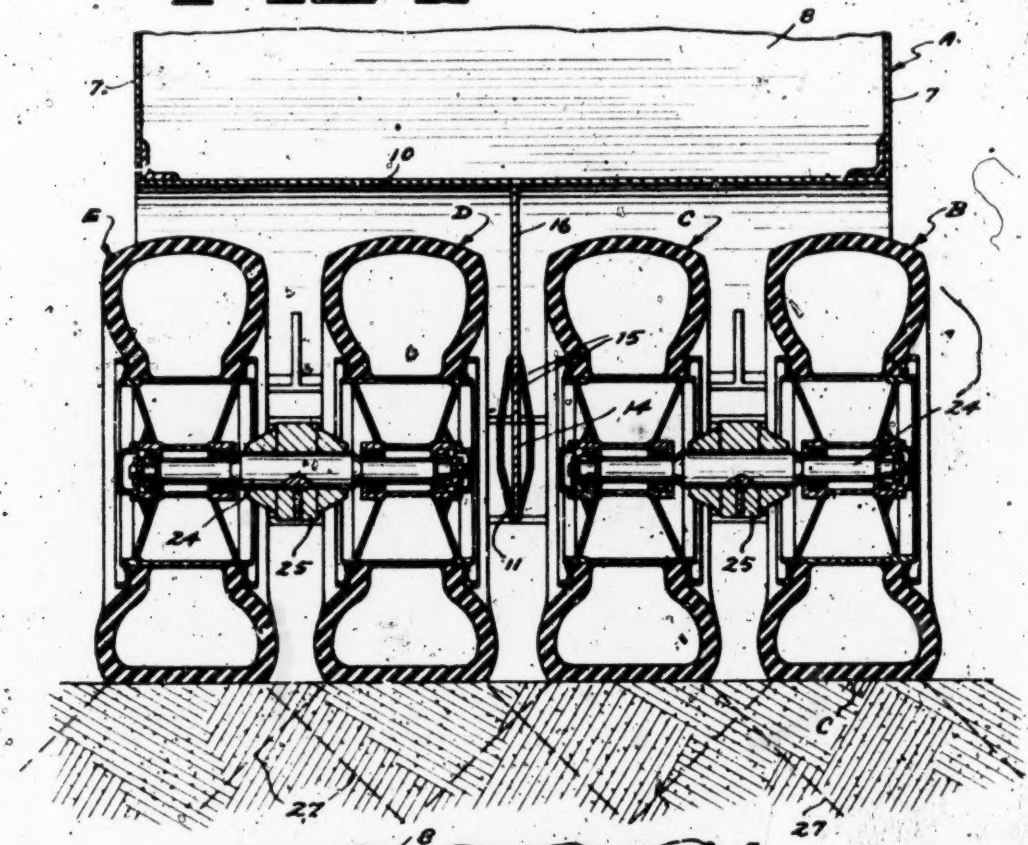
PNEUMATIC ROLLER COMPACTOR

Filed Nov. 17 1949

3 Sheets-Sheet 2

FIG 3



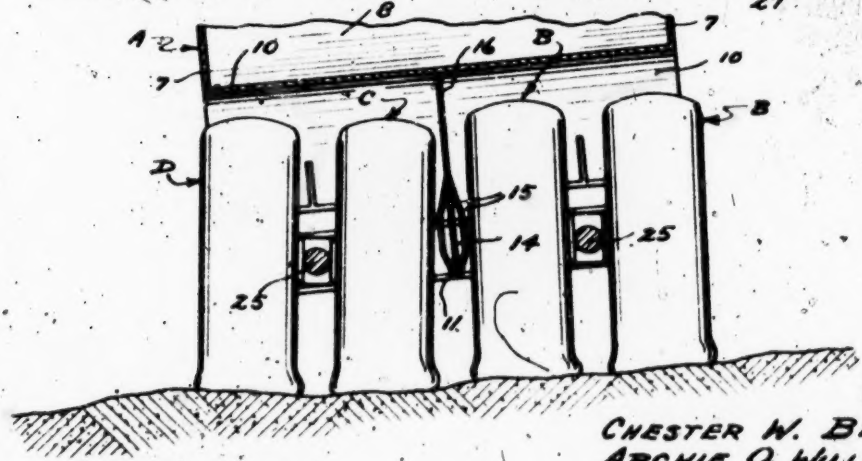


FIG 4

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PNEUMATIC ROLLER COMPACTOR

Filed Nov. 17, 1949 3 Sheets-Sheet 3

FIG 5

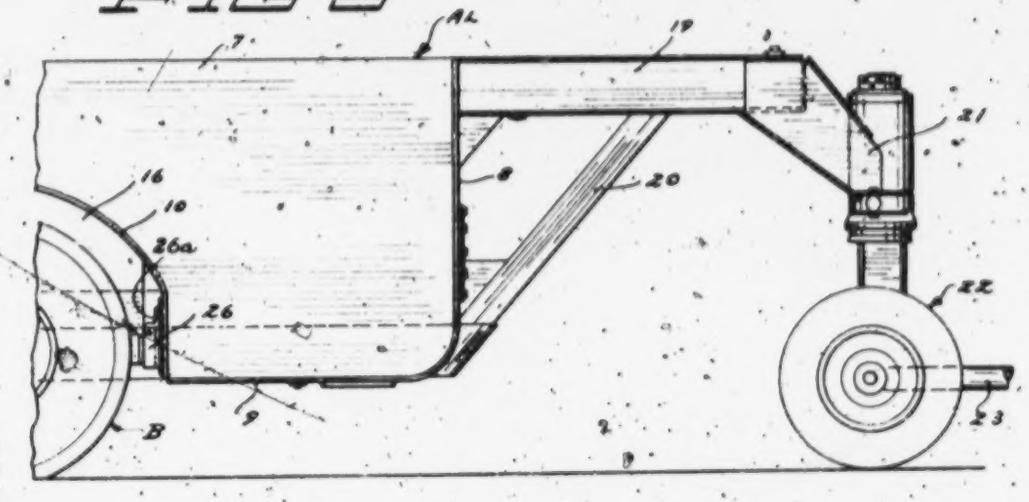
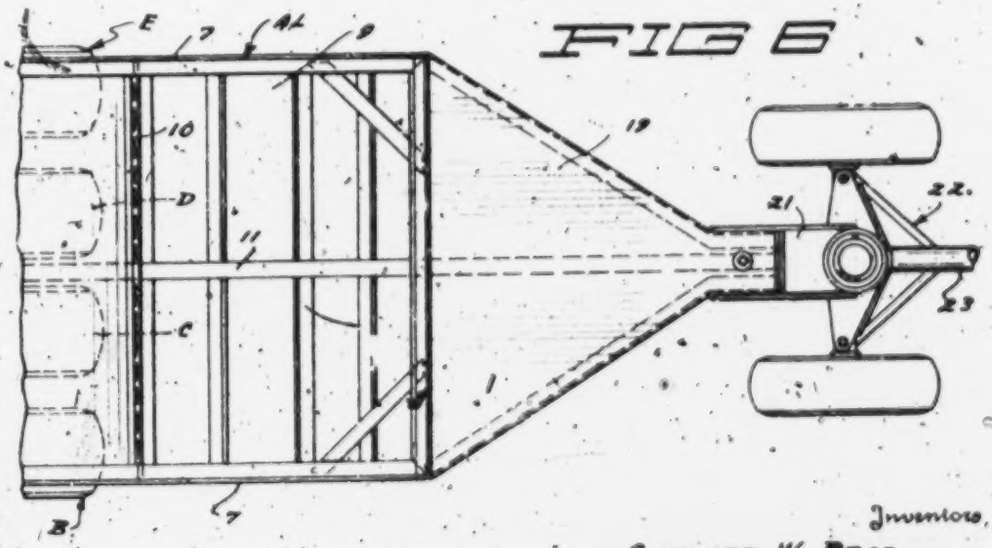


FIG 6



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UNITED STATES PATENT OFFICE

2,610,557

PNEUMATIC ROLLER COMPACTOR

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Application November 17, 1949, Serial No. 127,865

4 Claims. (Cl. 94—50)

1

This invention relates to the art of compacting earth for roads, highways, airport runways, fills for dams, etc. where deep penetration and uniform but maximum density are important objectives, and the primary purpose is to provide a novel, efficient and practical pneumatic tired compactor that will effectively yet economically meet these rigid objectives or requirements.

Soil stabilization and compaction problems are not new and have been efficiently solved in many instances and by various means. But with increased demands resulting from modern heavy traffic and load conditions the problem becomes more acute and critical, because unless the foundation soil structures are compacted or compressed by equipment at least as heavy as that which is to subsequently travel thereover there will be additional and irregular compaction and consolidation that will injuriously disrupt the surface condition that was prepared for such subsequent traffic.

A typical exigency is that represented by airport runways which must receive and support aircraft weighing as much as three hundred thousand pounds. The impact thus resulting, in effect, from wheel loads of one hundred fifty thousand pounds is such as to break down the runway pavement unless it is properly supported by base courses and subgrades that have been compacted to an extremely high degree of density and to a depth of as much as five to six feet below the surface.

The advantages resulting from the use of pneumatic tired compaction rollers have been recognized for some time. They produce a kneading and densification action, irrespective of ground surface irregularities, that is far superior to that obtained by hard steel rollers, regardless of size or weight.

It is also evident that the depth of pressure penetration and the degree of subgrade density will be increased by using larger tires and imposing heavier loads. It is found, however, that the problem cannot be solved by merely increasing size and weight of existing rollers because a number of practical and operational considerations intervene. These include, body rigidity, transport, maneuverability, cost, available tire and tractor power limitations, safety, weight concentration, and other important factors.

To obtain the required depth and density compaction loaded rollers of thirty-five to two hundred tons in weight are desirable. To be effective, this enormous weight must be applied over a relatively limited ground surface area, to prevent dissipation or lateral dispersion of the vertical pressures, and must also be uniformly distributed at all times to be supporting wheels so that no one of them will be subjected to weight pressure beyond which its pneumatic tire will support without blowing out. These tires must necessarily be of giant size, represent a very substantial investment, and their replacement or repair is accordingly an important item in the construction and maintenance cost of this equipment.

2

With the foregoing and other practical problems and technical difficulties in mind, we have developed and perfected a pneumatic tired compactor which has been thoroughly tested and found extremely practical and efficient in actual use. This machine is exemplified in the accompanying drawings, wherein—

Fig. 1 is a side elevation of a preferred form of our compactor showing it directly connected to a tractor.

Fig. 2 is an enlarged sectional plan view on the line 2—2 in Fig. 1.

Fig. 3 is a cross sectional elevation on the line 3—3 in Fig. 2.

Fig. 4 is an elevation, partly in cross section, showing the body and wheels in tilted positions as when travelling over an irregular surface.

Fig. 5 shows a modified form of machine in this instance the main body having a forward goose-neck draft structure for mounting on a dolly which is in turn connected to the pulling tractor.

Fig. 6 is a plan view of the structure shown in Fig. 5.

Referring to the drawings more particularly and by reference characters A (Figs. 1-4) designates a large steel box which forms the main body structure of the machine. This box is substantially rectangular, in plan, but in side elevation has an arched, transversely extended recess for the reception of the supporting wheels B, C, D and E. This results in deep wells, at fore and aft ends of the box, and the distribution of weight including ballast loaded into the box, is such that the center of gravity is directly over or slightly forward of the wheel axis so as to impose maximum load pressure on the tires.

When the machine is in operation it is loaded with ballast, such as wet sand, until the total weight approximates or exceeds thirty-five tons, with a result that the box is subjected to very great torsional and twisting stresses, particularly when moving over irregular terrain. To counteract these stresses and to provide a maxi-

mum degree of body rigidity and design and construction of the body proper becomes an important problem.

In the structure illustrated in Figs. 1–4, the body box is made up of heavy steel plate side, end and bottom walls 7, 8 and 9, respectively, all securely welded together, and a similarly secured arched bottom plate 10, over the wheels.

A draft beam 11 extends centrally and longitudinally through the entire length of the bottom of the box and forwardly therebeyond (Fig. 1) to a universal coupling 12 that connects it to the drawbar 13 of the tractor F. This draft beam may be of any substantial steel design, but is preferably narrow in width, and in the present instance comprises a center plate 14 and a pair of transversely curved or concaved side plates 15, all welded into a single rigid unit. This beam is also rigidly secured, preferably by welding, to the end walls 8, to the bottom wall 9, and to the vertical lower portions of the arched bottom plate 10. It will be seen that it connects these portions 10 (Fig. 2) by extending across the wheel recess, between the wheels C and D, so as to transmit the draft force directly to the rear of the box, but is sufficiently narrow, and in the transverse horizontal plane of the wheel axes, so as to permit the wheels C and D to be closely spaced with respect to each other. This position of the center beam is also such as to not interfere with the wheel unit oscillations as will presently be set forth.

It will also be noted that the upper arched portion of the plate 10 is reinforced by a generally semi-circular plate 16 which may be an integral extension of the beam 11 which extends forwardly beyond the box A is further rigidly connected to the forward wall 8 by a center gusset plate 17 and upwardly and outwardly diagonally extended brace bars 18.

In the modification shown in Figs. 5 and 6, the box A1, is substantially similar to the box A, except that the beam 11 does not extend directly forwardly to the draft vehicle. In this instance the roller has a generally goose-necked draft connection in the form of a hollow beam 19, which is triangular in plan and extends forwardly from the upper part of the box A1. This beam is then connected to the draft beam 11 by an inclined beam 20, and terminates in a casting 21 pivotally mounted on a two-wheeled dolly 22. The dolly thus forms an independent support for the roller and is merely connected to the tractor by a conventional draft tongue 23.

Returning now to the more critical wheel and tire construction, arrangement and function, it will be seen that the wheels are arranged in coaxially aligned pairs, the wheels of each pair being mounted on opposite ends of a shaft 24 the middle of which extends through and is rigidly secured in a fore-and-aft extending beam 25. The ends of the beams 25 are oscillatably mounted on each beam will be equally distributed to the two wheels mounted on it, as the wheels are free to oscillate or rock in a transverse vertical plane about the bearing centers of each beam. In short, if the gross weight of the machine is fifty tons (as in the tested pilot model) the ground pressure exerted by each tire will remain constant at approximately twelve and one-half tons per tire irrespective of anticipated ground contour irregularities. It will also be evident that since the wheels are disposed in a line substantially under the center (longitudinally) of load gravity, the ground surface pressure will be much more concentrated than if the load were carried between front and rear supporting wheels.

To produce the most effective compaction, in a single wheel series machine, it is recognized that the great weight required must not only be concentrated in a single transverse strip and equally distributed to the four wheels, but also that the wheels must be very close together in order to best utilize the combined down pressures and prevent the vertical compaction movement from escaping in the form of upward squeezing of soil between the wheels.

Our wheel mounting is such that the transverse space between the tires of each pair need be very little greater than the thickness of the oscillating or rocking beam 25 and the space between the tires C and D can be as narrow as the spaces between tires B—C or D—E. The effectiveness of this arrangement is illustrated in Fig. 3, where diverging dotted lines 27 indicated how the lateral dispersion of vertical pressures are coordinated so that the actual result is virtually the same as if the tires were immediately adjacent to each other, the intervening spaces being much too narrow to permit the upward escape of any appreciable compaction pressures. To the best of our knowledge no one has previously designed a machine that will thus concentrate compaction pressures while also equally distributing the weight to wheels that will accommodate themselves to irregular terrain. In this connection it may be noted that since the tires employed are of unusually large dimensions (outer diameter of five feet or over) the wheel axles cannot be mounted in vertically depending brackets if the wheels are to have both the required proximity and freedom for oscillation, as such brackets would interfere with such relationship and action. As the wheels are independently rotatable the entire machine can be turned in short radius, and the large tire diameters also insure that even soft ground will be rolled down and not pushed in a wave in advance of the wheels. Our experience indicates that within practicable size limits a machine embodying this invention is required to have not more nor less than four compaction tires.

It is understood that suitable changes or modi-

body member with its center of gravity substantially over the wheels, and a draft beam extending longitudinally through the lower part of the body, centrally thereof, said draft beam traversing said arched recess between two of such wheels and rigidly connecting opposite wall portions of the recess.

2. An earth compaction roller comprising a unitary hollow body member adapted to receive weight producing ballast and having a transversely extending arched recess substantially midway its front and rear ends, two pair of pneumatic tired wheels mounted in said recess, one pair under each half portion thereof, to support the body member with its longitudinal center of gravity substantially over the wheels and so the entire weight of the body will be transversely distributed to both pairs of wheels, a shaft in the recess mounting each pair of said wheels, a fore-and-aft extending support for each shaft positioned between each pair of wheels with each support oscillatably mounted whereby the wheels of each pair have freedom for oscillating movement with respect to its side of the body member and bearings for the fore-and-aft supports disposed at the lower ends of the arched recess, said supports maintaining the lower ends of the recess wall in parallelism.

3. An earth compaction roller comprising a unitary hollow body member forming a single frame and adapted to receive weight producing ballast, said body having a recess extending transversely thereunder, and across its entire width, four pneumatically tired wheels coaxially disposed in said recess, two under each side of the body member, said wheels being mounted in pairs, a shaft in the recess for mounting each pair of wheels, a fore-and-aft extending support in the recess for each shaft positioned between the wheels of each pair with the support oscillatably mounted and with its axis fixed with respect to the body member, whereby the wheels of each pair are free to oscillate about the axis of said supports, and a bearing beam disposed at each lower end of the transverse recess and in which the fore-and-aft supports are mounted, the wheel supporting shafts being parallel with and equidistantly spaced from said bearing beams, the entire imposed load of the body member and its ballast being transmitted equally to the four wheels, the wheels being spaced from each other and with the spacing between each two adjacent wheels being equal whereby the load supporting tires will compact the earth in four equally spaced paths and with equally distributed pressure on each path.

4. An earth compaction roller comprising a unitary hollow body member forming a single frame and adapted to receive weight producing ballast, said body having a recess extending transversely thereunder, and across its entire width, four pneumatically tired wheels coaxially disposed in said recess, two under each side of the body member, said wheels being mounted in pairs, a shaft in the recess for mounting each pair of wheels, a fore-and-aft extending support in the recess for each shaft positioned between the wheels of each pair with the support oscillatably mounted and with its axis fixed with respect to the body member, whereby the wheels of each pair are free to oscillate about the axis of said support, reinforcing means at the lower ends of the transverse recess and in which the support is mounted with the supports acting to maintain said lower ends in parallelism and in spaced relation, the entire imposed load of the body member and its ballast being transmitted equally to the four wheels, the wheels being spaced from each other and with the spacing between each two adjacent wheels being equal whereby the load supporting tires will compact the earth in four equally spaced paths and with equally distributed pressure on each path, and the spacing between the treads of each two adjacent tires being substantially less than the width of the tread of either of such tires whereby the compaction forces will not exert any substantial movement of earth material upwardly between the tires.

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ULYSS O. GUIGNARD.

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FIG. 1. THE PNEUMATIC ROLLER used at Lookout Point Dam had four wheels each pair mounted on opposite sides of a longitudinal trunnion to permit them to oscillate on rough ground (see Fig. 5). It was built by William Bros Boiler and Manufacturing Co. of Minneapolis.

Pneumatic rollers cut costs and time on earthfill dams

George E. Bertram

Engineer, Office of the Chief of Engineers
Washington, D. C.

Field tests of special types of pneumatic rollers conducted over the last five years have demonstrated to the satisfaction of soil experts of the Corps of Engineers that both time and money can be saved by the use of such rollers in the construction of rolled fill dams. Using rollers built to specifications developed by the corps as a result of these extensive test operations, it has been found possible to compact earth fills at about half the cost of obtaining comparable compaction by tamping rollers.

This reduction in cost is a direct reflection of the saving in time. However, it appears probable that the total benefit to a project resulting from the substitution of pneumatic rollers for sheepsfoot rollers may be much greater than the mere saving in the cost of rolling. For example, embankment materials containing a high percentage of cobbles and larger rock can be compacted in thick layers, thus eliminating the high cost of rock re-

2 The compaction of materials can be accomplished at higher moisture content than with tamping rollers. This is of particular importance where materials cannot be dried economically below optimum moisture.

3 Operations may be resumed earlier following rain as the pneumatic rolled fill absorbs less moisture than the tamped fill even though both are rolled with a smooth roller to facilitate drainage before the storm.

This feature should be of importance in sub-tropical climates where rains occur daily.

• **Studies began in 1947.**—The limitations of sheepsfoot rollers for the compaction of granular materials, silts, and combinations of rock and soil are well known. Also the compaction accomplished by rubber tired hauling equipment in traversing earth fills has long been recognized, and the routing of such equipment over a fill is frequently specified as a compaction method. Such routing of hauling equipment is not an entirely satisfactory procedure as it shows the delivery of material and the compaction is not uniform over the entire surface.

taining this type of equipment at full load under the severe working conditions on the embankment, the contractor substituted a more ruggedly constructed roller of his own design. This double axle roller had nine 16 x 20 in. tires and weighed about 50,000 lb loaded. It gave about the same unit pressure per inch of tread width as the highway model roller but the greater total weight was more effective in compacting the mixed gravel and clay.

• **First specifications written.**—Success with a pneumatic roller at Dorena Dam led to the preparation of specifications for what appeared to be a desirable type of pneumatic roller for use on earth fills at Lookout Point Dam, also in the Portland District.

Bids on two rollers that would meet those specifications were called in the spring of 1949. Briefly, the requirements set up in the specifications were as follows:

Each roller was to have a body suitable for ballast loading to a total weight of 70,000 lb, a width of 9 ft, and overall body and tongue length of 19 ft. The tongue length was required to be such that a 90-deg turn could be made, and it was to be designed to permit the rollers to be hauled at 25 mph by a Caterpillar D-8 tractor or its equivalent.

Tires were to be 24-ply, 18.00x24, of free-rolling, earthmoving type, and all wheels had to be free to oscillate over uneven ground. The design was to be such that weights on the tires could range from 200 lb per inch of tire width to at least 600 lb. when fully loaded.

The William Bros Boiler and Manufacturing Co., Minneapolis, Minn., was the successful bidder and supplied two rollers having a single rectangular weight box. Oscillation of the wheels is provided by mounting them in pairs on axles projecting from two longitudinal rocking beams. The wheels are equipped with grease-sealed roller bearings. One of the rollers on the job at Lookout Point is shown in Fig. 1.

The new rollers were used first in th
fil

kr-sq in. foot pressure was used on -in. layers, twelve passes of the roller ere required.

Only two passes of the pneumatic llers were needed to compact 12-in. ers of well graded river gravel with size range from ¾ in. to 12 in.

Further study led to the conclusion at the pneumatic rollers should be perated at tire pressures of 85 psi, aking four passes on 12-in. lifts. The contractors—a combination of Morrison-Knudsen Co., Peter Kiewit Sons, and Macco Corp.—elected to se a dark brown clayey silt, which s an optimum moisture content of 4 percent dry weight.

An average of 343 density tests ade during the 1950 and 1951 orking seasons gave 96.8 percent of tandard Proctor density, with 70 per- ent above 95 percent.

Experience showed that compaction planes could be eliminated by scarifying the top of each lift before placing the next layer, also that the speed of rolling could be stepped up to 5 mph.

That work is still in progress and will be completed during the 1953 working season.

• Tests at Lucky Peak Dam—Very similar results were obtained in building the 250-ft high Lucky Peak Dam near Boise, Idaho. There, a 90,000-lb. Bros Model 450 roller having tire pressures of 90 psi was used for both the random gravel fill and the core. Only two passes were required on 18-in. layers of the random material and four passes on 12-in. layers of the impervious core, which was a sandy clay placed with moisture at 19 percent of dry weight. The average of 313 tests on the core is 98 percent of standard Proctor density, with 72 percent reported to be above 95.

FIG. 2. A DIFFERENT TYPE of roller was tested at Whittier Narrows Dam. Each of its four rubber-tired wheels has an independent weight box hinged to a transverse shaft at the rear to permit independent vertical movement. This roller was made by the Southwest Welding and Manufacturing Co. of Alhambra, Calif.

• A second type of roller—A different type of roller was used for the east embankment of Whittier Narrows Dam near Los Angeles, where alternate specifications for pneumatic rollers and sheepsfoot rollers were prepared by the Los Angeles District in 1950. That dam is to be a 56-ft high flood-control structure with a core of sandy or clayey silt and sandy to lean clay with an average optimum moisture content of 12 percent dry weight. The pervious shell materials are sands and gravelly sands.

Modified Proctor density was to be used as a control for the laboratory testing and accordingly placement control was aimed at 90 percent of modified density.

Specifications required four passes of the pneumatic roller on 12-in. layers or eight passes of the sheepsfoot roller on 8-in. layers for impervious material, and four passes of the pneumatic roller on 18-in. layers or six passes of the sheepsfoot roller on 12-in. random pervious layers.

Winston Brothers Company, the contractor, obtained a Model LICR-4 pneumatic roller manufactured by the Southwest Welding and Manufacturing Co. Alhambra, Calif. This roller, shown in Fig. 2, is designed with each wheel assembly mounted in an independent weight-box unit to permit oscillation over uneven ground. The units are hinged together at the rear by a large tie-bar about which movement takes place. Diagonal bars at the sides provide stability and connect to a heavy gooseneck type draw-bar at the front. The tire size is 21 x 24 with a tire pressure of 65 psi at a rated weight of 100,000 lb loaded. The roller was moved by a D-8 Caterpillar tractor.

As the contractor elected to add

FIG. 4. A FOUR-WHEEL ROLLER somewhat larger than the one used at Lookout Point was used on the Garza-Little Elm Dam in Texas. Similar in design to the Bros roller, is a Ferguson Model RT-100-S from the Shovel Supply Co. of Dallas.

92 percent of standard Proctor density.

The select and random pervious fill was compacted by four passes of the HCR-4 roller on 18-in. layers. The average density obtained was 94 percent of modified Proctor density or 99 percent of standard.

• **Comparisons at Isabella Dam**—Direct comparisons between rollers were made possible at Isabella Dam in Sacramento by the fact that the initial work was done under two contracts. Sheepsfoot rollers having a total weight of 42,000 lb were used for the first contract and pneumatic rollers with wheel loads of 20,000 lb and tire pressures of 80 psi were used for later work. The pneumatic rollers were the same make as at Whittier Narrows, a Southwest Model HCR-4, but they were towed by a rubber-tired DW-20 tractor.

Soils were disintegrated granites, and the impervious material consisted of gravelly clayey sands and silty sands. They are slightly plastic and have an optimum moisture content of about 9 percent dry weight.

Specifications called for twelve passes of the heavy sheepsfoot roller on 12-in. layers of the impervious material or six passes of the pneumatic roller on 18-in. layers.

Macco Corp., River Construction Corp. and Morrison-Knudsen Co.—is using the same equipment to complete the main dam, which will be 185 ft high and contain 2,700,000 cu. yd.

• **A third type of roller**—Still another type of pneumatic roller was used in building the west embankment for the Garza-Little Elm Dam in Texas for the Fort Worth District. On that project the contractor—Joe W. Hendrix—used a Ferguson Model RT-100S pneumatic roller, shown in Fig. 4. It is similar to the Bros roller, employing two oscillating trunnions each carrying two wheels to permit load distribution on uneven ground. The roller was loaded to 25,000 lb per wheel; tire pressures were 90 lb on the 18x24 tires.

Alternate compaction specifications were used for that project, but because of uncertainties involved in compacting a wide variety of soils, layer thickness for both types of roller was set at 6 in. Borrow materials varied from sandy gravel to silty clay, but the bulk of the material placed ranged from slightly plastic brown clayey sands to grey or brown moderately plastic sand clays. Optimum moistures ranged from 9.5 to 14.5 percent dry weight.

After 350,000 cu. yd. had been placed with a tamping roller a change was made to the pneumatic roller but no change was made in the number of passes, which was eight on the 6-in. lift.

Densities obtained were substantially the same for each type, being 93.4 percent of modified Proctor for the sheepsfoot as compared with 93.0 for the pneumatic.

• **Roller specifications revised**—As a result of experience gained on these operations revisions were made on the specifications for pneumatic rollers for the compaction of earth embankments. The new specifications, dated April, 1952, require that such rollers shall have a minimum of four wheels equipped with tires of such size and ply that tire pressures can be between 80 and 100 lb under a 25,000-lb wheel load during rolling operations.

Wheels must be abreast and so designed that each will carry approximately equal loads in traversing unequal ground. Wheel spacing shall be such that the distance between the nearest edges of adjacent tires is not greater than 50 percent of tire when operations are being carried out under the 25,000-lb load.

Rollers are required to have a rigid steel frame and a body such that ballast loading may be varied to produce individual wheel loads ranging from 18,000 to 25,000 lb.

The entire assembly (roller plus tractor) must be capable of executing a 180-deg. turn on a 15-ft radius. Roller speeds have been raised to a maximum of 10 mph. This change is expected to result in greater use of rubber-tired towing equipment in place of crawling tractors.